I N S T I T U T E R E P O R T

O N

Instructional Materials Development in Mathematics for Visually Handicapped

held at

American Printing House for the Blind
Louisville, Kentucky
April 9 - 11, 1970

Frank L. Franks, Coordinator
Educational Materials, Development and Research
Instructional Materials Reference Center

The purpose of the Mathematics Institute was to examine areas in mathematics where deficits in instructional materials for visually handicapped are believed to exist, to identify specific aids necessary for teaching basic concepts in these areas, and to suggest priorities for development of relevant aids and materials.

Idenfication of materials deficits in mathematics

Analysis of deficits in instructional materials in mathematics proceeded from readiness materials in kindergarten and primary grades to advanced materials in senior high mathematics courses.

Instructional needs were analyzed to:

1) Identify curriculum areas in mathematics where greatest deficits for visually handicapped students were felt to occur.
2) Establish priorities in specific areas for in-depth examination.
3) Suggest priorities for initiating development of relevant aids and materials.

Discussion outline

Content units in the identified deficit areas were discussed. Basic concepts were examined. Discussion was guided by the following questions:

a. What is the purpose of the unit?

b. What concepts are taught?

c. What instruments or instructional materials are required to teach these concepts?

d. Are the instruments and materials available? Can they be developed, or adapted from existing materials?

e. Are there alternate techniques or methods for teaching these concepts which can be utilized to simplify the materials problem?

f. What suggestions do you have for overcoming or eliminating the deficit?

Mathematics Institute Organizers

Frank L. Franks, Coordinator
Educational Materials, Development and Research
Instructional Materials Reference Center
American Printing House for the Blind

Ralph E. McCracken, Assistant Editor
Editorial Department
American Printing House for the Blind

Mathematics Institute Participants

Dr. Robert Bruce
Virginia School for the Blind
Staunton, Virginia 24401

Dr. Mae Davidow
Overbrook School for the Blind
Sixty-fourth Street and Malvern Avenue
Philadelphia, Pa. 15151

Mr. A. H. Evancic
Western Pennsylvania School for Blind Children
Bayard Street at Bellefield
Pittsburgh, Pennsylvania 15313

Mrs. Dixie Howser
Kentucky School for the Blind
1867 Frankfort Avenue
Louisville, Kentucky 40206

Mr. Daniel Kopecky
Texas School for the Blind
1100 West 45th Street
Austin, Texas 78756

Mrs. Harold Sachs
409 Spruce Lane
East Meadow, New York 11554

BOCES, Nassau County,
New York

I N S T I T U T E P R O G R A M

Instructional Materials Development in Mathematics for Visually Handicapped

American Printing House for the Blind
Louisville, Kentucky
April 9 - 11, 1970

Thursday

9:00 - 10:00	Welcome, Introductions, Purpose of the Institute
10:30 - 12:00	Primary Level Mathematics (Readiness materials, kindergarten, grades 1-3) DAVIDOW
1:30 - 3:00	Primary Level Mathematics--Summary
3:30 - 4:30	Intermediate Level Mathematics (Grades 4 - 6) BRUCE

Friday

8:30 - 10:00	Intermediate Level Mathematics--Summary
10:30 - 12:00	Junior High Level Mathematics KOPECKY
1:30 - 3:00	Junior High Mathematics--Summary
3:30 - 4:30	Senior High Mathematics EVANCIC

Saturday

9:00 - 10:00	Senior High Mathematics--Summary
10:30 - 12:00	Overall Summary Session

Tours of the Instructional Materials Reference Center and of the Mathematics Display area will be available Thursday morning, 8 - 9AM.

Introductory materials

Primary measurement kit. Analyze textbooks to determine the kinds of instruments needed in the primary grades for introducing measurement concepts (including measurement of temperature) to young blind students. Using appropriate instruments, develop a measurement kit in mathematics similar to the science measurement kit.

Simple geometric forms. A series of three different sizes of the Edmund Scientific basic solid set (no. 60,249), should be included in this set of forms. One set should be the size of the above set, one set 2 times larger and one set 4 times larger.

Hollow geometric forms. Various simple forms which can be filled with sand or water, and the contents weighed to determine volume, should be included in the set. Size and volume capacity, should be determined by textbook analysis.

Plane figures. Simple plane figures to complement the above forms should be developed.

3-D materials. In thermaform, to go along with the forms and plane figures mentioned above. These will enable the student to go from the actual geometric form, to a plane figure, to a 3-D representation in developing better concepts of diagrams illustrated in brailled textbooks. (This series is continued in the next section.) Some of these materials are available from:

LaPine Scientific Company
6001 South Knox Avenue
Chicago, Illinois 60629

These forms, figures and materials will orient blind students in understanding representation of solids in math figures appearing in textbooks.

Light weight plastic containers. There is a need for lightweight plastic containers in a firm unbreakable plastic which will not bend in use as those currently available do. (Bending of containers allows liquids to spill.)

Numberaid. Schott's Numberaid is a good teaching tool--for basic number concepts. It should be retained. There is good transition from it to the abacus.

Abacus. The abacus should be accepted as the basic tool for mathematical computation. It should be utilized for performing more mathematical operations than are taught by most mathematics teachers in early grades. Those include computations with fractions, solving proportions, finding square root, doing exercise with complements, and computing with logarithms.

The following should be replaced by the abacus:

1) The calculaid
2) The cubarithm slate
3) The Texas slate
4) The Taylor slate

Primary abacus. Develop a larger abacus, one-third larger than the existing one. The beads should be enlarged by one-third. This abacus will also be valuable for multiply handicapped students. (Maintain the 13 columns.)

Number line. Develop a good numberline with two slides, desk size...with zero (0) indicated at the center. It should be lightweight and sturdy.

Place value device. A board for counting and comparison of number should be constructed. (A number can be shown in relationship to others, as larger or smaller....)

The clock. The current APH clock should have longer hands; get rid of the arrow (on the hour hand). All of the works in the clock are not necessary. The clock is good for teaching:

1) modular arithmetic (but larger hands are needed)
2) number of degrees around a circle
3) other concepts related to time

An adhesive back for use in showing degrees, or differenct rims which can be fitted on the clock for use in teaching differenct concepts. (Also for different modular number, e.g., mod 5, mod 8, mod 15, etc.)

Braille is too far out on the rim of the APH clock. It may be easier to lengthen the hands than to make other adjustments with the braille.

Intermediate

Put-together kits. Kits should be constructed which will allow the student to develop or put together geometric forms. Solids and plane figures should be included.

Fractional equivalents and decimals equivalents aid. A simple device for teaching fractional and decimal equivalents should be developed. The device should illustrate the comparison of fractional parts to that of a whole, and to other fractional parts. It should be compact, lightweight, and less expensive, than those now available.

Intermediate geometric forms. A packet containing six squares and a metal frame to form a cube illustrates the kind of geometric forms to be included in the set. The squares should be made of durable, flexible plastic, if possible. This example can be used to expand a square and to measure its capacity and volume. (Some of these may already be available.) Other examples include six rectangles with frame to build a rectangular prism: Four triangles with frame to form a pyramid: Two circles with wrap-around strip to form a cylinder; etc.

Linear measurement. Yardstick, meter stick and a folding ruler and/or tape should be developed for linear measurement.

Graph board. Investigate the development of a better graph board than the graphic aid to mathematics. It should be smaller, lighter in weight, and should use elastic thread. The principal axes should be clearly defined so that an origion and the four quadrants are clearly indicated. The grid for the positive axis and negative axis should be easily discriminated.

Raised line drawing kit. Develop a better kit than the Sewell, but one in which lines drawn will appear as raised lines. The electrostatic build up on the Sewell causes the sheets to come off the base during use and the Sewell dries out. A better or different quality of paper should be considered for use with the kit.

Double-faced pegboard. A double-faced pegboard should be developed until zing elastic thread and pegs that fit for constructing rectolinear figures on one side and for constructing curvilinear figures on the other. The blind student can be instructed how to construct his own figures.

The pegboard should be larger than nine by nine inches. Some investigation, research and textbook analysis may be necessary to determine the best size pegboard for constructing figures. Axes should be easily discriminated.

Advanced materials

A quadrant board with grid. This board can be used for teaching principle axes to blind students. A better graph board will eliminate this board.

Coordinate 3-D aid. Explore this potential of a 3-D aid as applied in describing intersecting planes and lines in space.

Pythagorean theorem triangle set The set should include 3; 4; 5; 6; 8; 10; and 5; 12; and 13 right triangles. This aid is used for

teaching that the sum of the squares of the legs of a right triangle is equal to the hypotenuse squared and other pythagorean concepts. It is valuable also for teaching:

1) Eighth grade math (where it is introduced)
2) For algebra
3) Squaring of numbers
4) Solving the right triangle

Slide rule. Investigate the need for a slide rule--a rectangular one, perhaps--for blind students. The one available is inadequate.

Training materials for college board examinations in mathematics. A 12 page pamphlet of examples of different size figures on grids should be developed in braille and large print to give students opportunity for practice in computing areas, perimeters, and order of size. Solid lines on a solid and/or dotted grid should be used. (Straight lines for grids and dotted lines for figures?)

Computer math. Developments in computer mathematics should be followed with a view toward materials development if and when a need is indicated.

Kit for geometric drawings and constructions. This kit should include:

1) A base one-half the size of the Sewell board
2) A ruler

3) Special paper

4) A compass

5) A protractor

6) Possibly a special pen

Protractor. Develop further the APH mock-up. Its size is good.

Compass. Attach a control on the compass developed which will allow setting of the radius without having to measure the legs of the compass against a ruler. Set screws on each end should be included to keep it from coming apart or slipping while performing operations in drawing and construction of figures. (Check the AFB compass.)

Is a circular device needed to show degrees of an angle? What attachments for holding paper secure?

The Howe Press Drawing Kit may be sasisfactory for drawing figures, but a vertex can not be clearly indicated. (Good workmanship; but poor for use in teaching geometry.)

Raised line drawing tools kit. Investigate the possibility of developing a kit of tools and materials which blind students can use for making their own graphs, maps, etc. It would include:

1) Assorted wheels which make different kinds of lines

2) Assorted symbols

3) Texture assortment

Areas recommended for research

What is the best average size for the drawing of geometric figures and for the figures themselves, at different grade levels?

Recommendations

1) Existing instructional materials, kits and individual aids in mathematics available from commercial distributors should be evaluated to determine their usefulness for blind and partially seeing students. The best representatives should be considered for adaptation if they have instructional value for visually handicapped students.

2) The IMRC should alert central catalog users to materials available in mathematics which have proven useful to visually handicapped students, without adaptation. These materials should be evaluated by educators or specialists who have used the aids or have seen them in use in educational programs.

3) Participants in the Mathematics Institute recommend the abacus as the best mathematical computational aid available at the present time. Along with the four fundemental processes of mathematics computation with whole numbers, the abacus can be used in computations with fractions, decimals, extracting of roots, percentages, conversion to different bases, ratio and proportion, logarithms, etc.

4) Instructional procedures for using instruments and aids developed and/or adapted should be provided in elementary language in braille and in large print.

5) Teachers' manuals for the above should be prepared where possible, with guidelines for use in various curriculum areas across grades.

6) Appropriate IMRC personnel should be available to demonstrate at regional centers and meetings, at inservice programs, and at special conferences, tangible apparatus and equipment developed for visually handicapped students. Emphasis would be on demonstration as opposed to display of materials.

7) Participants expressed concern and interest in education of visually handicapped students in public schools and residential school settings, and recognize that visually handicapped students in public school programs integrated in sighted classes may have particular problems in instruction which should be considered in the development, testing and evaluation of instructional materials.

8) Institutes, in other academic areas, similar to this Institute, should be considered.

9) Relevant information from this and other Institutes should be made available to educators in the field.

10) Participants in the Mathematics Institute agree to cooperate in so far as possible in the realization and implementation of the recommendations made herein

Additional recommendation to be included:

Investigate and explore the development of a mathematics laboratory for illustrating a range of mathematical concepts from simple, introductory concepts to sophisticated mathematical processes in higher mathematics, perhaps including business machines.

Such a laboratory would be a place for a student to experiment, explore and discover and solve mathematical problems.

The materials included in the laboratory should help the visually handicapped student progress from concrete to abstract concepts in mathematics.